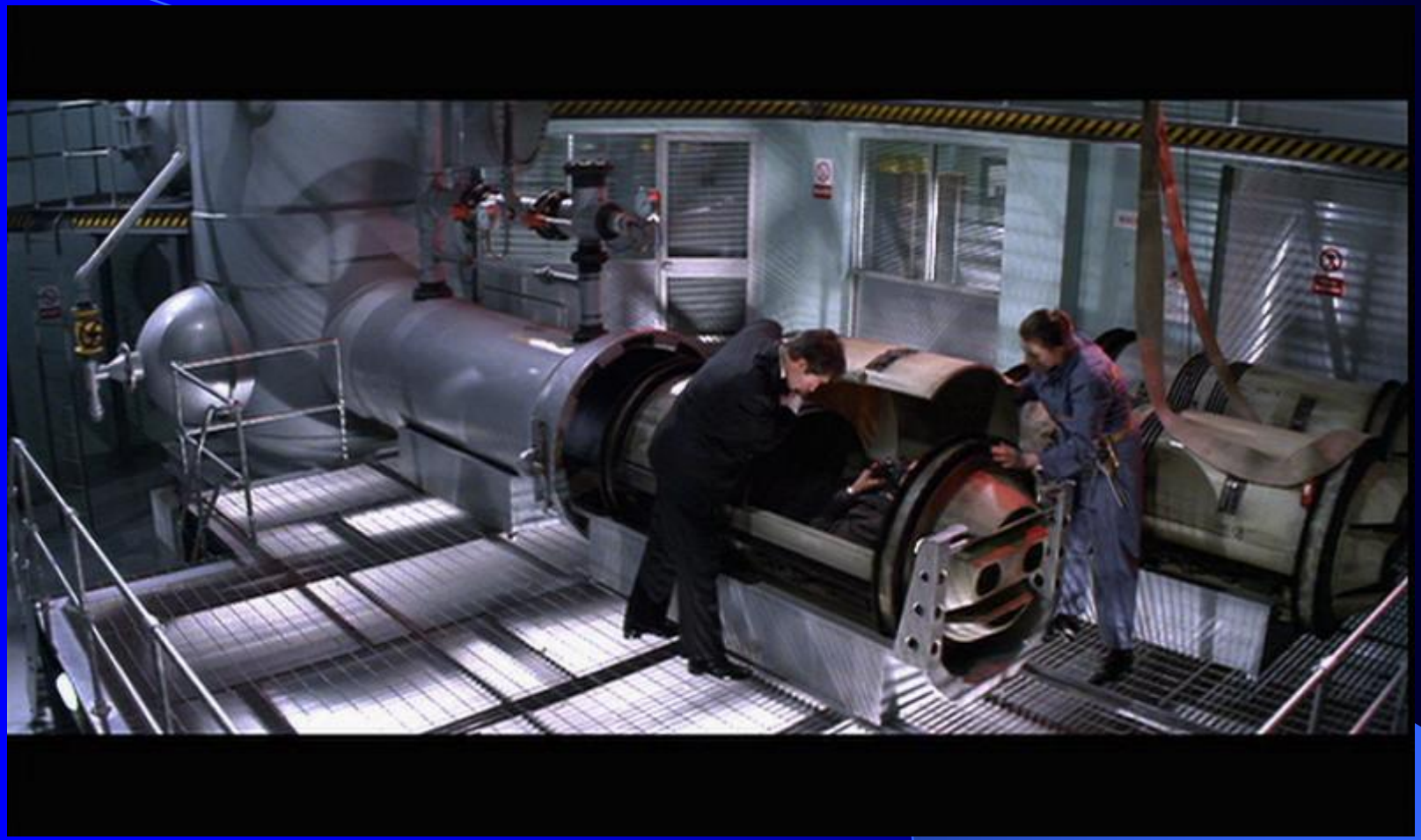
Was that a world record ?

Exchange of 32 pipes of crude oil pipeline DN 500 within 88 hours

CEPS a.s.
Jesenice u Prahy
Czech Republic

It was a result of smart pigging

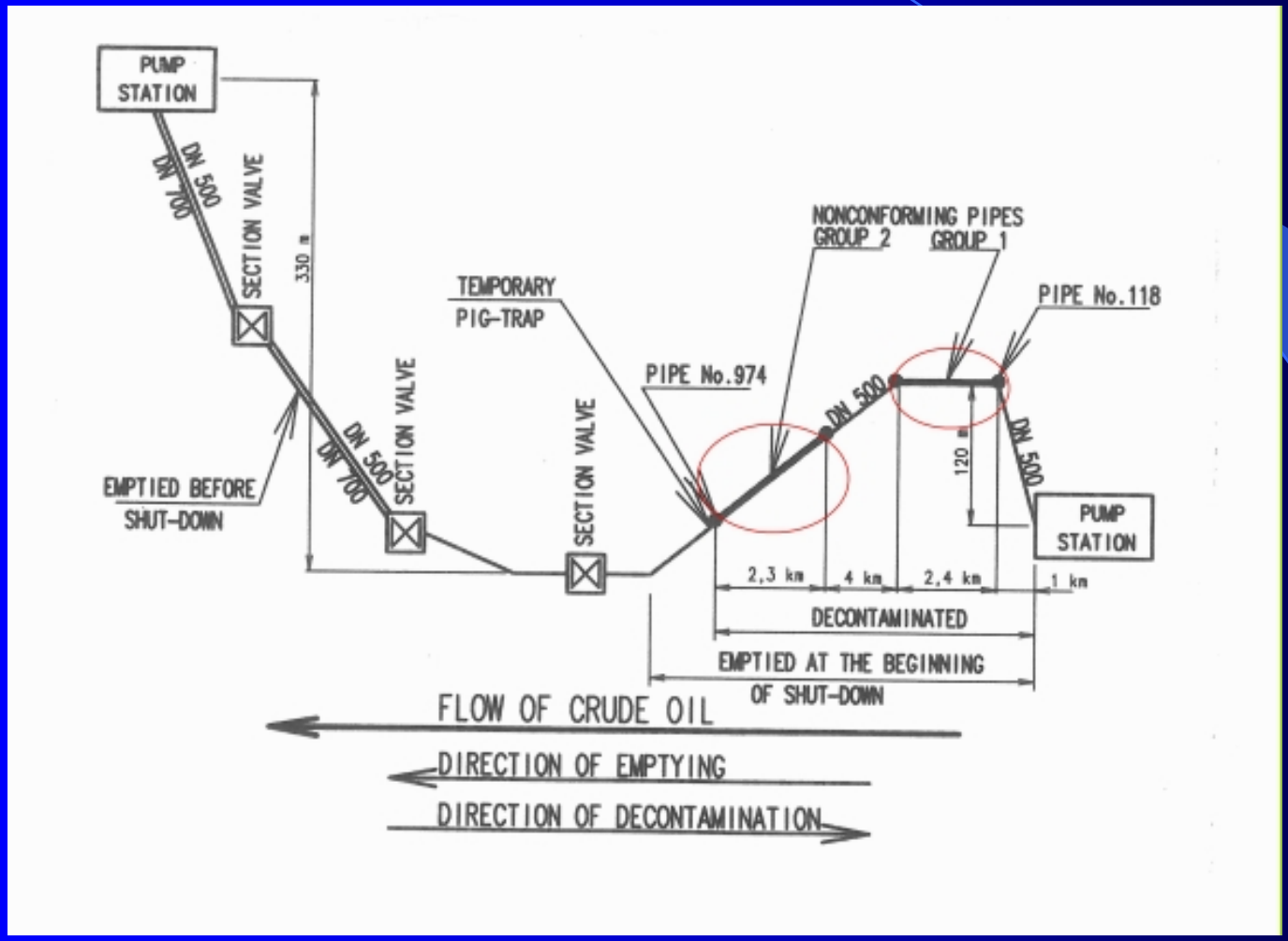


32 pipes had been evaluated as nonconforming

These 32 pipes with unsatisfactorily small thickness (construction error in 1965) were distributed to nearly

10 km of pipeline

Situation



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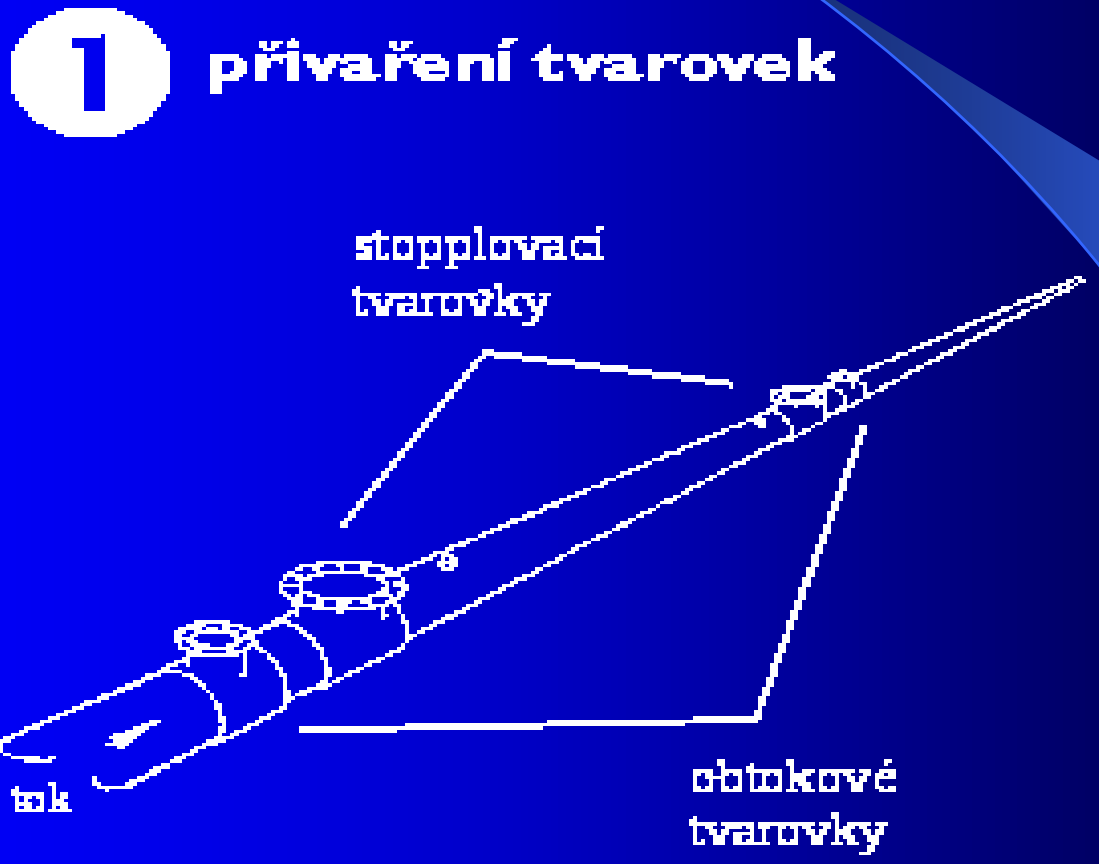
It was necessary to cut out these pipes and replace them by new ones

What is

the standard solution ?

Temporary plugging of the pipeline and replacing the pipes



Closing the Line Using T.D.W. Stopple

Oil Removing from the Space for Welding

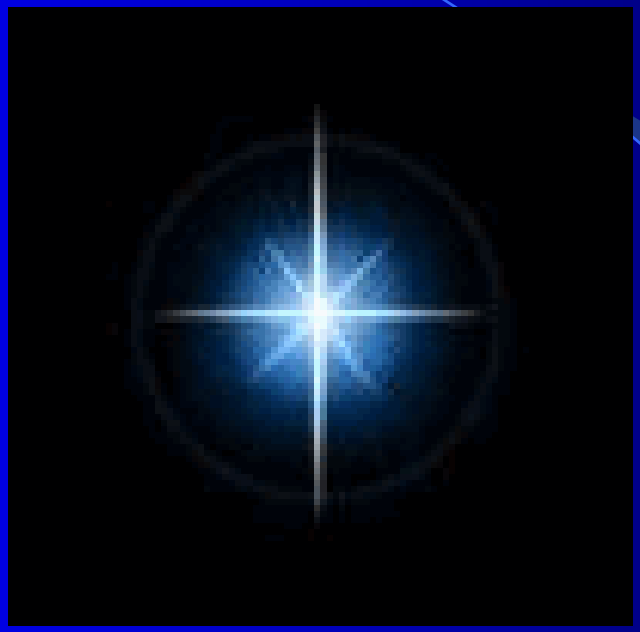
Cutting out the Pipe to be Replaced

But – there is the extremely big case:
32 pipes having to be replaced in such a short time window

Is it even possible ?

NO !

CEPS has found quite different solution



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What are the necessary conditions for replacing of the pipes ?

1. The pipes, to be replaced have to be empty - free of the crude oil
2. The atmosphere inside the pipe has to be safe from the point of view of welding

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It is possible to fulfill these two conditions by this way

1. Isolation of pipeline part, to be repaired
2. Pushing out the crude from all the length of this pipeline part
3. Cleaning – decontamination of all the length of this pipeline part, to reach the inner space of pipeline absolutely free of oil vapors

What does it mean the decontamination ?

The decontamination of crude oil pipeline means the entire cleaning and degreasing of the line, in order to remove even traces of oil on the pipeline inner wall to reach zero concentration of hydrocarbons in the air inside the pipeline

This technology was primarily developed for the case of oil pipelines, to be safely abandoned, in order to preserve the environment, especially to preserve underground water.

To reach this goal, the special cleaning agent Petrosol was developed, based on the mixture of organic and inorganic surfactants.

In addition to high cleaning efficiency Petrosol has got one favorable characteristic – the surfactant which was used during the cleaning and containing oil, is easily disposed by biodegradation.

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In this project the first time CEPS has decided to empty and decontaminate the pipeline, scheduled for repair. It's a way to ensure a non-explosive atmosphere in the entire length of the line.

Thus the entire part of pipeline is prepared for repair, because of safe atmosphere enables to work everywhere at the entire length of line simultaneously

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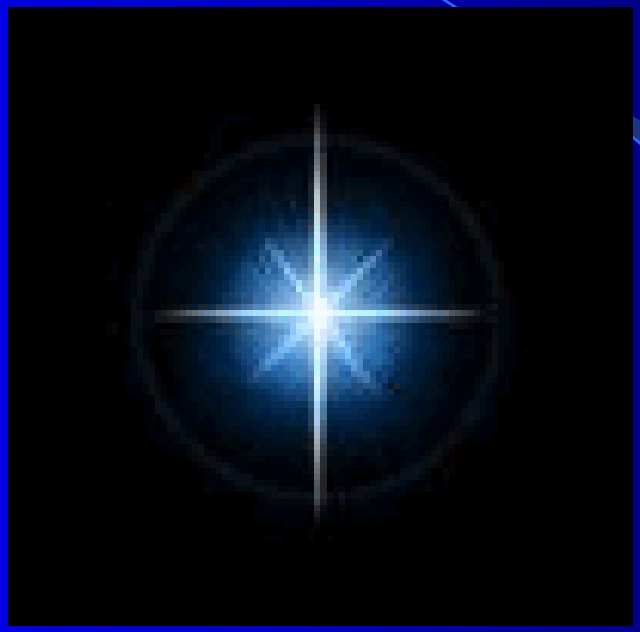
The time needed for the decontamination is some 20 hours and after this short time the pipeline is prepared for repair



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Good idea …

… but there is another problem, which needs to be solved

The pipeline has to be empty and there is some 2.500 m^3 crude oil inside !

The emptying of the part of pipeline that will be repaired is possible by two ways

The first solution - to move the crude oil using the pigs, which will be pushed in the downstream direction by compressed air

But there is the problem - in downstream direction the pipeline rises about 330 m - it means that needed pressure is more than 33 bar. There was no available source with so high output pressure and sufficient capacity.

The second solution - to displace the crude oil using road tank trucks to the nearest pumping station

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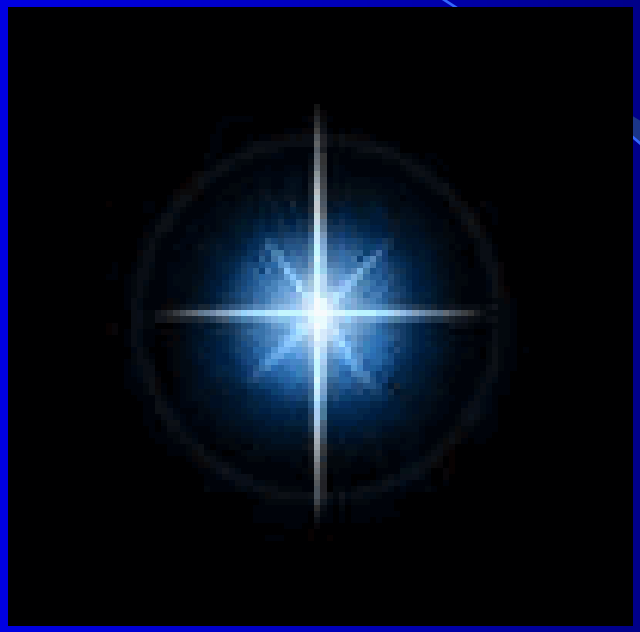
But there is a problem of time - the transport of 2.500 m^3 of crude oil means some 250 trips of tank truck, and even when some 10 truck is available, it is not possible to do it during several hours

Fortunately project manager has found another clever solution



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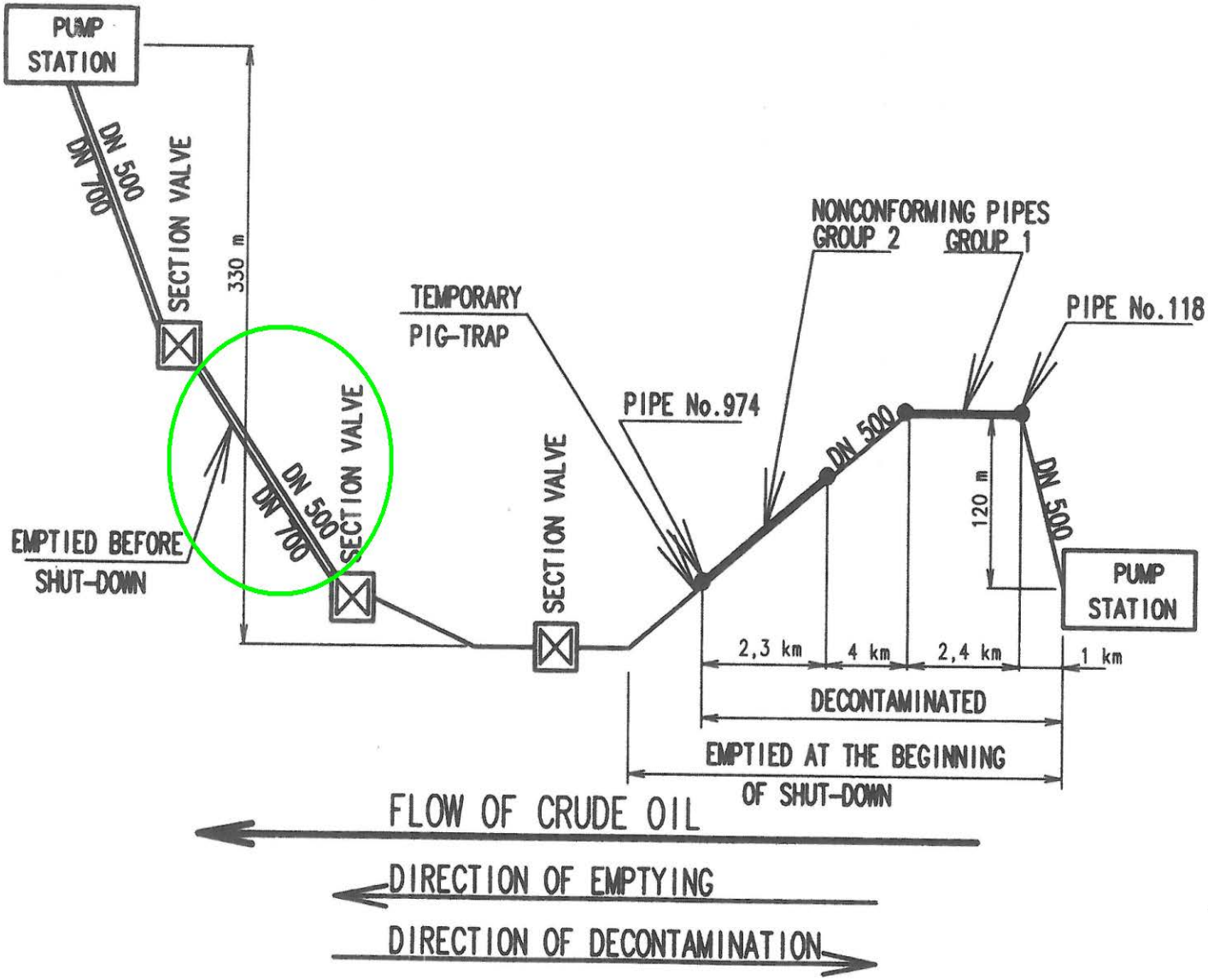
Some 20 km in the downstream direction begins the parallel pipeline DN 700


PUMP STATION
DN 500
DN 700
SECTION VALVE
330 m
EMPTIED BEFORE SHUT-DOWN
DN 500
DN 700
SECTION VALVE
TEMPORARY PIG-TRAP
SECTION VALVE
PIPE No.974
NONCONFORMING PIPES
GROUP 2
GROUP 1
PIPE No.118
DN 500
120 m
DN 500
PUMP STATION
2,3 km
4 km
2,4 km
1 km
DECONTAMINATED
EMPTIED AT THE BEGINNING OF SHUT-DOWN
FLOW OF CRUDE OIL
DIRECTION OF EMPTYING
DIRECTION OF DECONTAMINATION

In that time the capacity of this DN 700 pipeline was not necessary for the operation

So it was possible to empty a part of the DN 700 in advance before the beginning of the shutdown of DN 500 pipeline and …

… by this way to prepare the capacity for quick displacement of crude oil from the part of DN 500 pipeline planned for repair

Finally everything was conceived and the project can start

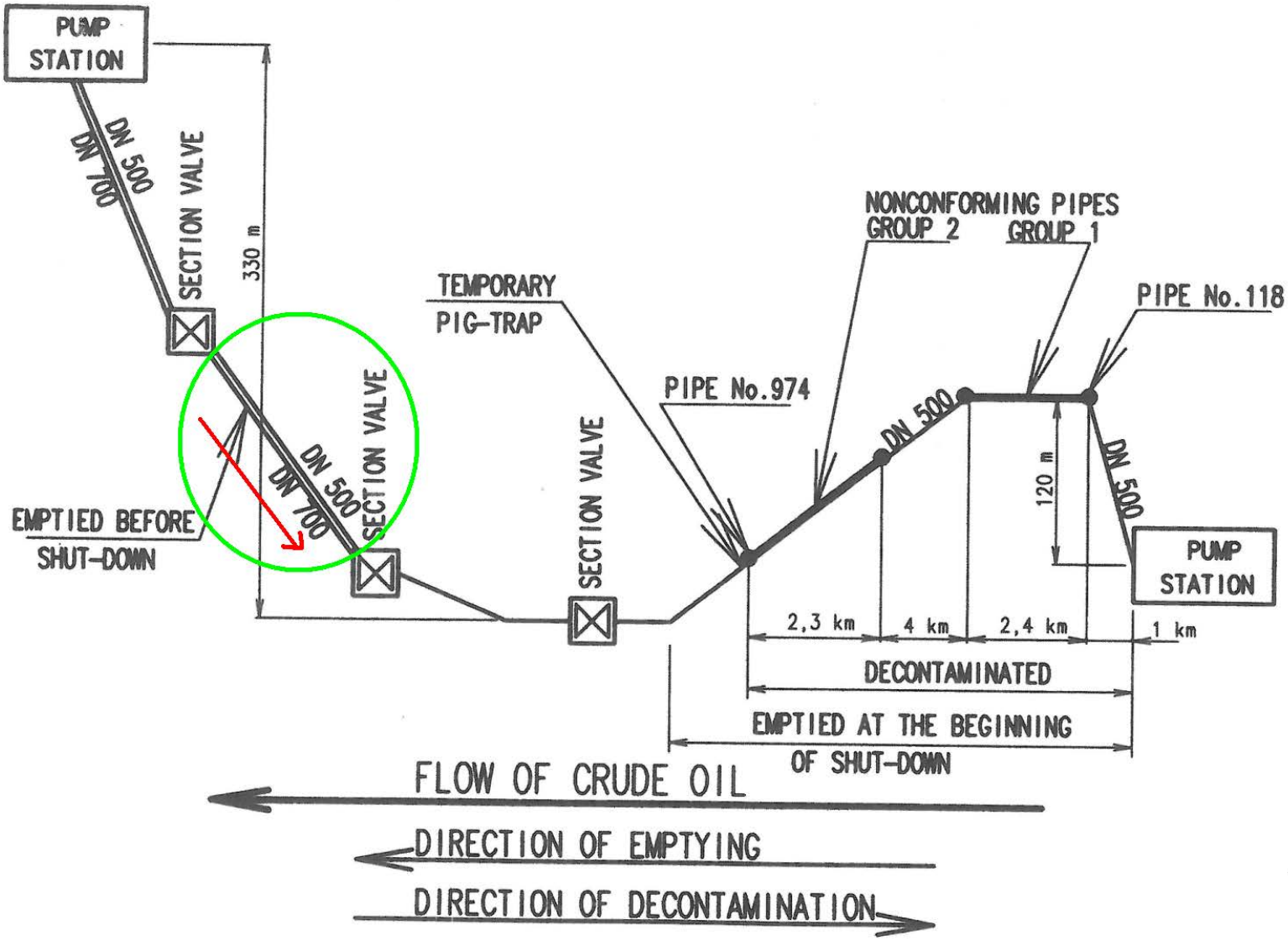
Before the construction the entire process has been thoroughly discussed with the managements of both pipeline operator and all construction companies involved in the project

MittalArcelor Ostrava had manufactured the new pipes for the repair, fulfilling the special specification:
OD 530 mm and asphalt coating, according to
the original pipeline material

Ten days before the pipeline shutdown, the preliminary works were done

- emptying of crude oil from DN 700 pipeline
- preparing of individual job sites

The emptying of a part of DN 700 pipeline was done using the pig pushed downhill in the direction from the upper end of the emptied part, the crude oil was moved to tank trucks at the lower end, than the oil was transported to storage site.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The crude oil was displaced to tank trucks at the lower end, and the oil was transported to storage site.

The emptying of a part of DN 700 pipeline took 5 days, when 8 tank trucks performed the job.

Displacement of Crude Oil from DN 700 Pipeline

Preparing of each job site included four steps

1. Finding the places of the nonconforming pipes by GPS according to results of on-line pigging

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2. Digging out the pipeline and removing the coating

3. Checking of the right place and the right pipe

☺

(really important step)

The „right“ pipe was confirmed

- by checking the length between the field welds
- checking wall thickness of the pipe and the next pipes upstream and downstream
- checking the position of helical and circumferential welds (in the case of HW pipes)

4. Transport of one new pipe to the job site

It looks very easy, but the day before, heavy rain came …

☹

The day before the shutdown of the pipeline, the project manager checks all the people and machinery on individual job sites.

Now, everything is really prepared …

Ready, steady, go !

The Race Starts

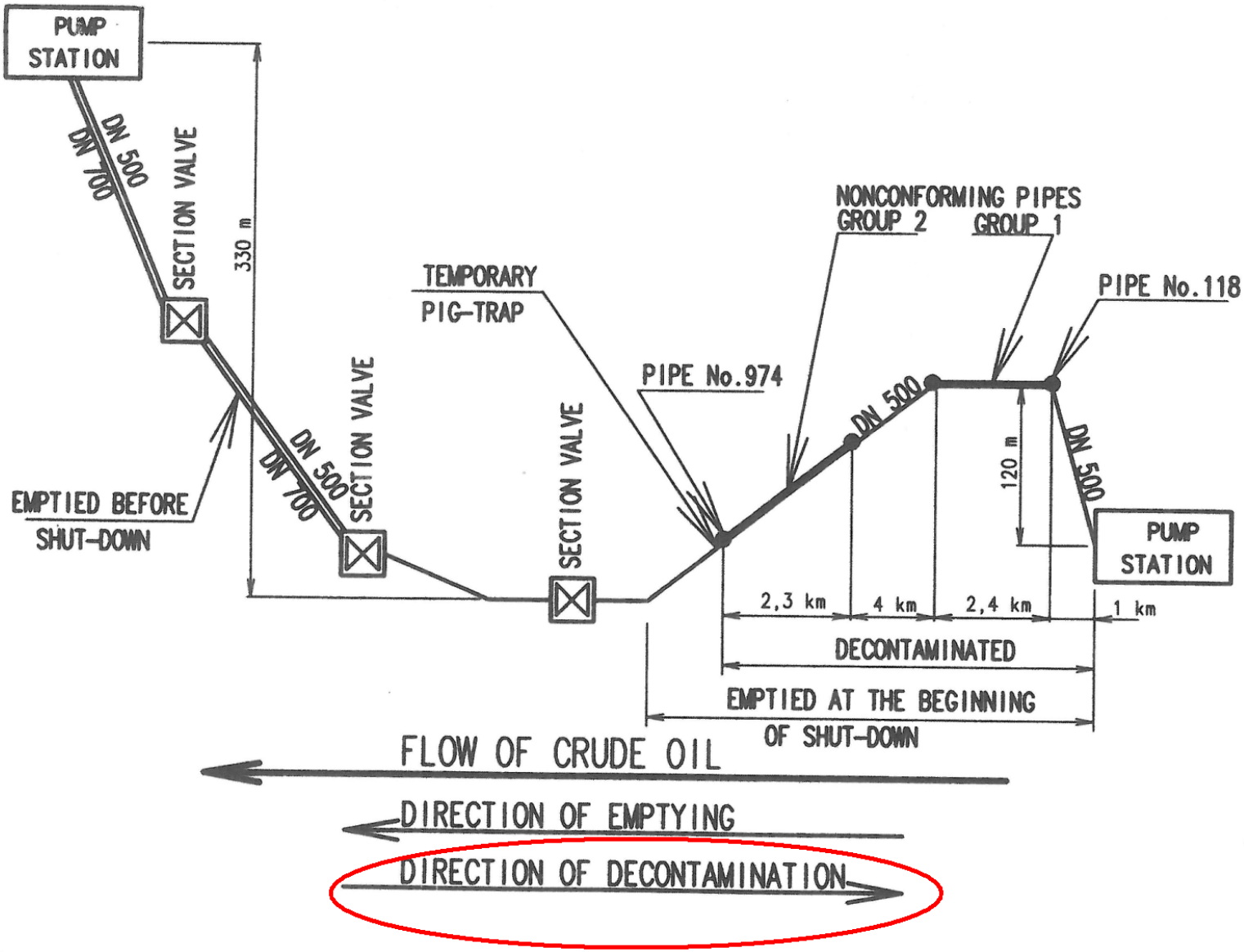
DATE : September, 17th, 2007

TIME : 6:00 CET

TIME ELAPSED : 0 hours

The flow of crude oil is stopped.

The pig, which was pushed through the pipeline from upstream pumping station, moved the crude oil into the pre-emptied pipeline DN 700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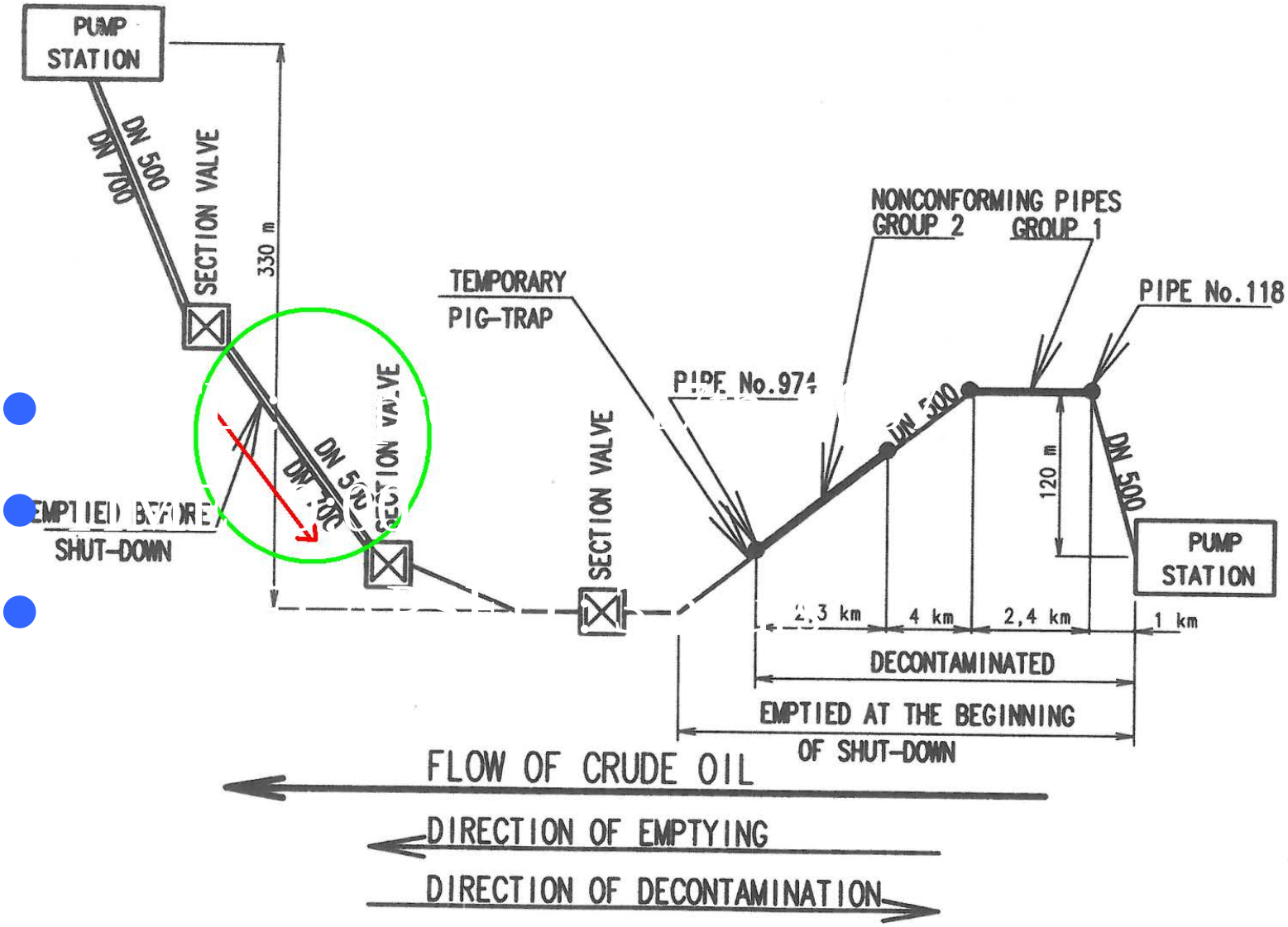
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The last downstream pipe (No. 974), which was planned to be replaced, had been cut out using flameless technology. The next downstream pipe (No. 975) is closed by PLP sealing pig.

Preparing of the Repaired Part for Decontamination Starts

DATE : September, 17th, 2007

TIME : 12:00 CET

TIME ELAPSED : 6 hours

The opened pipeline was temporarily sealed by clay plug. The end of pipe was manually cleaned to ensure safe welding area.

The temporary cleaning pig trap was welded onto the pipeline end.

Pipeline with Temporary Cleaning Pig Trap

Several bi-di pigs was put into the temporary pig trap. The spaces between the individual pigs were stepwise filled by the Petrosol surfactant in different concentration.

The speed of pig train, the amount of solution and individual concentrations are calculated on the base of mass transfer of oil residues into the surfactant.

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Tank-truck for Transport and Preparing of Cleaning Agent Petrosol Solutions

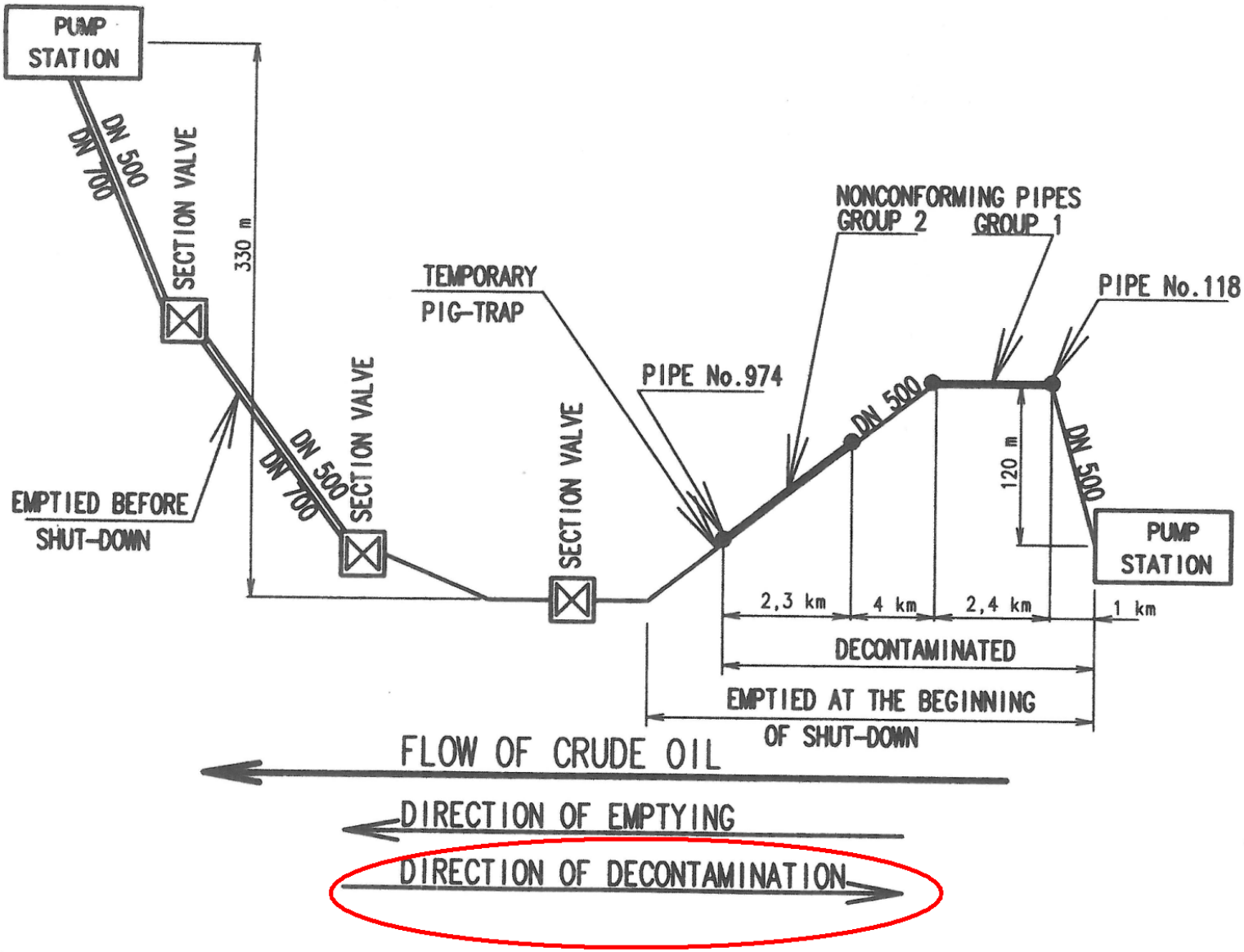
The Decontamination Starts

DATE : September, 17th, 2007

TIME : 23:00 CET

TIME ELAPSED : 17 hours

The pig train was moved by compressed air from the end of pipeline part which is repaired, in the opposite direction – towards upstream pumping station, where used solution will be pumped into the tank trucks.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Moving the Pig Train by Compressed Air

Moving the Pig Train by Compressed Air

Pipeline before Cleaning – Note the Oil on the Wall

Really Clean Pipeline Prepared for Repair

The Pig Train Reaches the Pumping Station

DATE : September, 18th, 2007

TIME : 10:30 CET

TIME ELAPSED : 28,5 hours

The used cleaning agent is pumped from the pipeline into the tank trucks to be transported to ecological biodegradation.

The air from the pipeline is checked for traces of flammable hydrocarbon vapors, when the pipeline was depressurized.

Decontamination Finished

DATE : September, 18th, 2007

TIME : 18:00 CET

TIME ELAPSED : 36 hours

After depressurization the explosion-safe space inside the pipeline was verified in several places.

The Entire Part of Pipeline Is Ready for the Repair !

DATE : September, 18th, 2007

TIME : 18:30 CET

TIME ELAPSED : 36,5 hours

Nearly 100 people, 14 welding teams and 5 mobile NDT laboratories simultaneously start the work

The View of 5 Individual Job Sites

First 6 cut-outs made

DATE : September, 18th, 2007

TIME : 20:00 CET

TIME ELAPSED : 38 hours

At each individual job site the cut-out was made, the new pipe welded on and NDT performed.

Cut-Out of the Nonconforming Pipe

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Another problem came - the pipeline wall was intensively magnetized due to the run of MFL on-line tool. The magnetic force was strong enough to catch the hammer.
It was really not good for welding.

Pipeline Wall Magnetization

The residual magnetic field was compensated using the wrapping the pipe by loops of welding cables.

The Compensation of Pipeline Wall Magnetization during the Welding

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All the 32 cut-outs made, 16 pipes replaced

DATE : September, 19th, 2007

TIME : 20:00 CET

TIME ELAPSED : 62 hours

The working teams are running to the second part of the race

At several places the situation really was not easy

Position of the Pipeline at Site No. 118

Last welds, last NDTs

Finish

NDT of the Last Weld Successfully Passed

The Pipeline Repaired Is Ready for the Operation

DATE : September, 20th, 2007

TIME : 21:30 CET

TIME ELAPSED : 87,5 hours

Since that time this technology is routinely used by CEPS for preparing of large repairs of longer pipelines at their entire length.

The decontamination-before-repair approach brings valuable benefits:

- enable to speed up large repairs,
- enhances safety of welding work,
- improves ecology of repairs,
- lowers costs of repairs.

During last four years, the decontamination before repair was performed at over 500 km of pipelines for crude oil and petrol products transport in Czech and Slovak Republic

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